

What is Claimed is:

1. An electromagnetic control valve comprising:

a valve body having first and second ports for communicating an inside and an outside of the valve, an orifice inside thereof for making the first and the second ports in communication, and a space inside of an upper part thereof;

a permanent magnet fitted in the space to be movable in an up/down direction;

a coil connected to a circuit and wound on an outside circumferential surface of the valve body;

a first yoke fitted to surround the outside circumferential surface of the valve body at a position opposite to an upper part of the permanent magnet for sustaining a levitated state of the permanent magnet by a magnetic force; and

a needle having a tapered tip disposed at a position opposite to a side of the orifice, for making linear variation of an opened area of the orifice while the needle moves together with the permanent magnet when the permanent magnet moves up or down by an electromagnetic force generated when a current is applied to the coil.

2. The valve as claimed in claim 1, wherein the valve body has a long cylindrical form disposed in the up/down direction.

3. The valve as claimed in claim 1, wherein the valve body includes detachable three pieces.

4. The valve as claimed in claim 1, wherein the first port is formed in a bottom of the valve body, and the second port is formed in a point of the outside circumferential surface of

the valve body.

5. The valve as claimed in claim 4, wherein the first port and the second port are formed in a vertical direction to each other.

6. The valve as claimed in claim 4, wherein the valve body includes;
a first piece having the outside circumferential surface the coil and the first yoke joined thereto, and an inside the permanent magnet held therein,
a second piece having an outside circumferential surface with the second port formed therein, an opened bottom, and a cavity formed therein for positioning the needle therein when the second piece is connected to the bottom of the first piece, and
a third piece having the orifice formed therein, connected to a bottom of the second piece to dispose the needle at a position opposite to the orifice.

7. The valve as claimed in claim 6, wherein the first piece is formed of a nonmagnetic substance.

8. The valve as claimed in claim 1, wherein the first port is formed in the bottom of the valve body, and the second port is formed in a top of the valve body.

9. The valve as claimed in claim 8, wherein the permanent magnet includes at least one vertical flow passage to make the second port and the orifice in communication.

10. The valve as claimed in claim 8, wherein the permanent magnet includes a

plurality of flow passages formed in a radial direction.

11. The valve as claimed in claim 8, wherein the valve body includes;

a first piece having the second port formed in a top thereof, the outside circumferential surface the coil and the first yoke joined thereto, and an inside the permanent magnet held therein,

a second piece having opened top and bottom, an outside circumferential surface with the coil wound on a part thereof, and a cavity formed therein for positioning the needle therein when the second piece is connected to the bottom of the first piece, and

a third piece having the orifice formed therein, connected to a bottom of the second piece to dispose the needle at a position opposite to the orifice.

12. The valve as claimed in claim 11, wherein the first and second pieces are formed of a nonmagnetic substance.

13. The valve as claimed in claim 11, wherein the first port and the second port are formed on a straight line.

14. The valve as claimed in claim 1, wherein the valve body includes a cap detachably fitted thereto.

15. The valve as claimed in claim 14, wherein the cap is formed of a nonmagnetic substance.

16. The valve as claimed in claim 14, wherein the second port is formed in a central part of the cap in the up/down direction.

17. The valve as claimed in claim 14, further comprising a limiter fitted between the cap and the permanent magnet for reducing a horizontal sectional area of the space to limit a moving up height of the permanent magnet.

18. The valve as claimed in claim 17, wherein the limiter has a ring form with an inside diameter smaller than an outside diameter of the permanent magnet.

19. The valve as claimed in claim 17, wherein the limiter is formed of a nonmagnetic substance.

20. The valve as claimed in claim 1, further comprising a limiter fitted in an upper part of the space for reducing a horizontal sectional area of the space to limit a moving up height of the permanent magnet.

21. The valve as claimed in claim 1, wherein the first yoke is formed of a substance having a high permeability.

22. The valve as claimed in claim 1, further comprising a second yoke mounted on the outside circumferential surface of the valve body to surround the coil.

23. The valve as claimed in claim 22, wherein the second yoke is formed of a

substance having a high permeability.

24. The valve as claimed in claim 22, wherein the second yoke includes;
an upper piece mounted to enclose the upper part of the coil, and
a lower piece mounted to enclose the lower part of the coil.

25. The valve as claimed in claim 1, wherein the needle is connected to a lower part of the rod fitted to pass the permanent magnet, for moving together with the permanent magnet.

26. The valve as claimed in claim 25, wherein the rod is formed of a nonmagnetic substance.

27. The valve as claimed in claim 1, wherein the needle is connected to the permanent magnet directly.

28. The valve as claimed in claim 25, further comprising at least one spring fitted such that parts thereof fastened to the valve body and the rod for preventing the permanent magnet, the rod, or the needle come into contact with an inside wall of the valve body, and providing a restoration force for the permanent magnet to restore to an original position, when the permanent magnet moves.

29. The valve as claimed in claim 28, wherein the spring includes;
a first spring for supporting an upper part of the rod passed through the permanent

magnet, and

a second spring for supporting a lower part of the rod connected to the needle.

30. The valve as claimed in claim 28, wherein the first or second spring includes;

a first ring fastened to the valve body,

a second ring inside of the first ring having an inside circumference an outside circumference of the rod is inserted therein, and

suspenders connected between the first ring and the second ring each having a great stiffness in a radial direction of the first ring and an elasticity in an up/down direction of the first ring.

31. The valve as claimed in claim 28, wherein the springs are formed of a nonmagnetic substance.

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32. The valve as claimed in claim 1, wherein the needle is disposed to close the orifice in a state no current is applied to the coil.

33. The valve as claimed in claim 1, wherein the needle is disposed to open the orifice fully in a state no current is applied to the coil.

34. The valve as claimed in claim 1, wherein the needle is disposed to such that the tip thereof occupies a portion of the opened area of the orifice in a state no current is applied to the coil.

35. The valve as claimed in claim 1, wherein the electric circuit is a circuit that can control an intensity and a direction of the current applied to the coil as required so that the needle can linearly increase/decrease the opened area of the orifice.

36. The valve as claimed in claim 35, wherein the electric circuit includes a PWM circuit (pulse width modulation circuit) that can control digitized frequency and pulse width of an applied current as required.

37. The valve as claimed in claim 1, wherein the electric circuit is a circuit that can apply a current of a preset intensity to the coil so that the needle opens or closes the orifice as a bistable on/off valve.

38. The valve as claimed in claim 1, wherein the first port has an inlet tube for introducing a high pressure fluid thereto, and the second port has an outlet tube for discharging a fluid passed through the orifice.

39. The valve as claimed in claim 38, wherein the orifice has a diameter smaller than a diameter of the first port for dropping pressure and temperature of the fluid after the fluid passes the orifice.

40. The valve as claimed in claim 1, wherein the second port has an inlet tube for introducing a high pressure fluid thereto, and the first port has an outlet tube for discharging a fluid passed through the orifice.

41. The valve as claimed in claim 1, wherein the fluid introduced into the valve body, passes through the orifice, and discharged to an outside of the valve is in a gas state.

42. The valve as claimed in claim 1, wherein the fluid introduced into the valve body, passes through the orifice, and discharged to an outside of the valve is in a liquid state.

43. The valve as claimed in claim 1, wherein the fluid introduced into the valve body, passes through the orifice, and discharged to an outside of the valve is in a gas and liquid mixed state.

44. The valve as claimed in claim 1, wherein the fluid introduced into the valve body, passes through the orifice, and discharged to an outside of the valve is a super critical fluid.